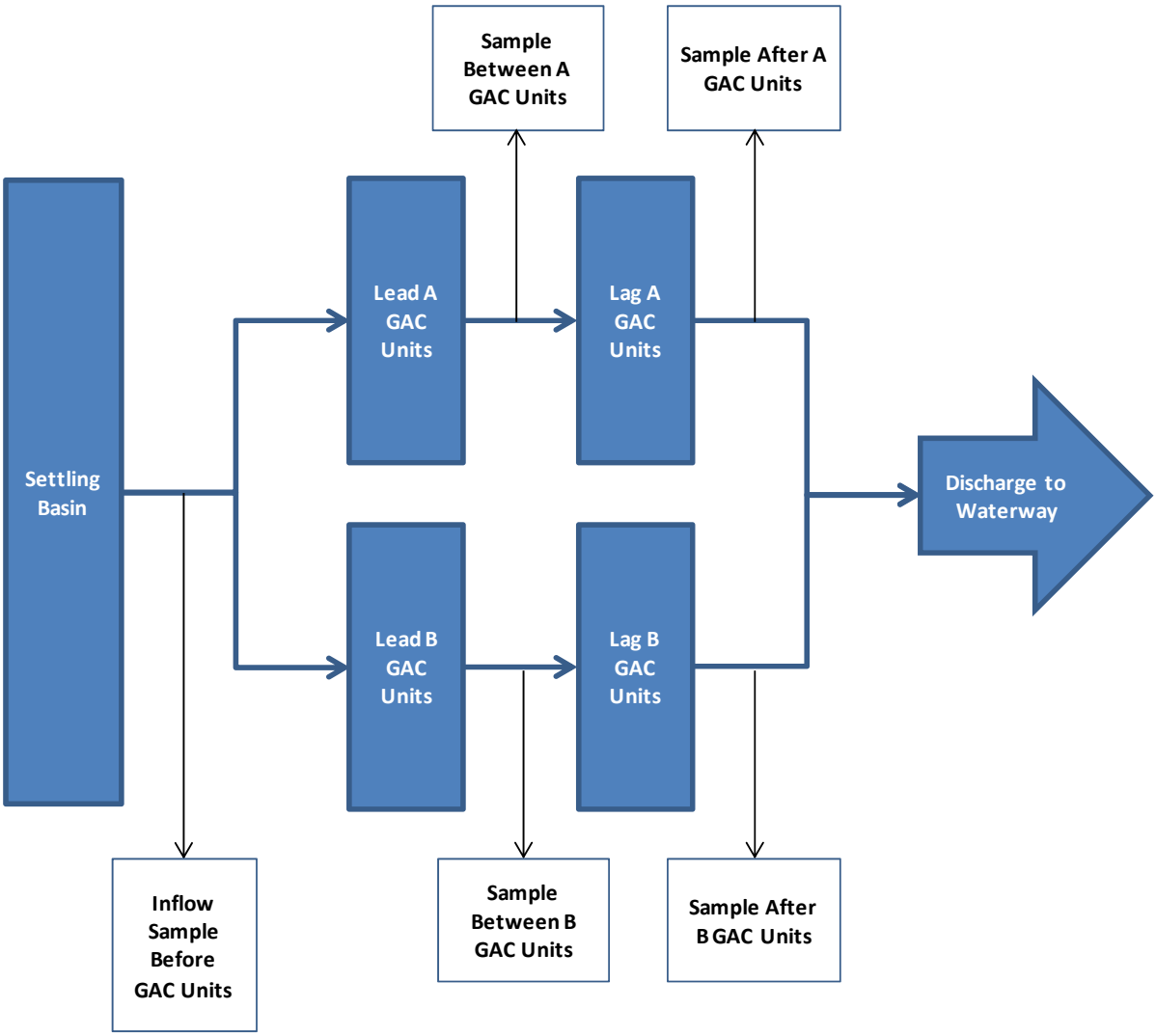
APPENDIX D

Granulated Activated Carbon Breakthrough Monitoring

Granular Activated Carbon Breakthrough Monitoring

Samples for analysis of polychlorinated biphenyls (PCBs) were collected from the granular activated carbon (GAC) vessels bi-weekly during construction season 3 (CS3), which extended from September 2014 to March 2015, to monitor for breakthrough in the GAC vessels. Four 10,000-pound GAC vessels were set up in two parallel sets ("A" vessels and "B" vessels) of two GAC units in series (Lead and Lag vessels) to remove PCBs (Figure 1). Samples were collected at the inflow to the two lead GAC vessels, between each of the lead and lag vessels, and at the effluent of each lag GAC vessel following Washington State Department of Ecology requirements.

FIGURE 1 GAC SAMPLING SCHEMATIC



Total PCB concentrations (Table 1) measured at the inflow ranged from non-detect (less than 0.01 micrograms per liter [μg/L]) to as high as 0.245 μg/L (November 21, 2014). PCB concentrations measured at the between sample locations were consistently non-detect with the exception of a single detection (0.018 μg/L) between the B vessels on December 4, 2014. After investigation, it was found that extremely cold temperatures had likely caused channeling to occur in the GAC units, resulting in less efficient GAC treatment. However, results for the lag samples demonstrate that the lag GAC vessels effectively removed the remaining PCBs to non-detectable levels. As a result of this finding, GAC operation procedures were updated, and the GAC vessels were monitored more closely to prevent further performance issues during cold weather.

All effluent samples (samples after A and B units) were non-detect for PCBs. Breakthrough did not occur during CS3.

TABLE 1

PCB CONCENTRATIONS IN GAC BREAKTHROUGH SAMPLES [1,2]

Granular Activated Carbon Breakthrough Monitoring
Duwamish Sediment Other Area and Southwest Bank
Corrective Measure and Habitat Project
Boeing Plant 2
Seattle/Tukwila, Washington

Sample Date	9/25/2014					10/9/2014				
Sample Type	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units
Sample ID	INF-092514	BTWA-092514	EFFA-092514	BTWB-092514	EFFB-092514	INF-100914	BTWA-100914	EFFA-100914	BTWB-100914	EFFB-100914
PCBs (µg/L)										
Aroclor 1016	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232	0.015 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs	**0.011**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U

Sample Date	10/23/2014					11/7/2014				
Sample Type	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units
Sample ID	INF-102314	BTWA-102314	EFFA-102314	BTWB-102314	EFFB-102314	INF-110714	BTWA-110714	EFFA-110714	BTWB-110714	EFFB-110714
PCBs (µg/L)										
Aroclor 1016	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.079**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.079**	0.010 U	0.010 U	0.010 U	0.010 U

Sample Date	11/21/2014					12/4/2014				
Sample Type	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units
Sample ID	INF-112114	BTWA-112114	EFFA-112114	BTWB-112114	EFFB-112114	INF-120414	BTWA-120414	EFFA-120414	BTWB-120414	EFFB-120414
PCBs (µg/L)										
Aroclor 1016	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242	**0.19**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248	0.010 U	0.010 U	0.018 J	0.010 U	0.010 U	**0.11**	0.010 U	0.010 U	**0.018 J**	0.010 U
Aroclor 1254	**0.055**	0.010 U	0.010 U	0.010 U	0.010 U	**0.05**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232	0.010 U	0.015 U	0.040 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs	**0.245**	0.010 U	0.010 U	0.010 U	0.010 U	**0.16**	0.010 U	0.010 U	**0.018 J**	0.010 U

Sample Date	12/18/2014					1/8/2015				
Sample Type	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units
Sample ID	INF-121814	BTWA-121814	EFFA-121814	BTWB-121814	EFFB-121814	INF-010815	BTWA-010815	EFFA-010815	BTWB-010815	EFFB-010815
PCBs (µg/L)										
Aroclor 1016	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242	**0.058**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.046**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.029**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.012 U	0.010 U	0.010 U
Total PCBs	**0.058**	0.010 U	0.010 U	0.010 U	0.010 U	**0.075**	0.010 U	0.010 U	0.018 J	0.010 U

Sample Date	1/23/2015					2/5/2015				
Sample Type	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units
Sample ID	INF-012315	BTWA-012315	EFFA-012315	BTWB-012315	EFFB-012315	INF-020515	BTWA-020515	EFFA-020515	BTWB-020515	EFFB-020515
PCBs (µg/L)										
Aroclor 1016	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248	**0.018**	0.010 U	0.010 U	0.010 U	0.010 U	**0.019**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.013**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs	**0.018**	0.010 U	0.010 U	0.010 U	0.010 U	**0.032**	0.010 U	0.010 U	0.018 J	0.010 U

Sample Date	2/19/2015				
Sample Type	Inflow Before GAC Units	Sample Between "A" GAC Units	Sample After "A" GAC Units	Sample Between "B" GAC Units	Sample After "B" GAC Units
Sample ID	INF-021915	BTWA-021915	EFFA-021915	BTWB-021915	EFFB-021915
PCBs (µg/L)					
Aroclor 1016	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1242	**0.018**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1248	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1254	**0.014**	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1260	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1221	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Aroclor 1232	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total PCBs	**0.032**	0.010 U	0.010 U	0.010 U	0.010 U

Note(s)
1. PCB analysis using EPA Method 8082.
2. U = indicates that the target analyte was not detected at the reporting limit provided. Detected results shown in **bold** type.

Abbreviation(s)

BTW = between	EPA = U.S. Environmental Protection Agency	INF = influent	µg/L = micrograms per liter
EFF = effluent	GAC = granulated activated carbon	PCBs = polychlorinated biphenyls	